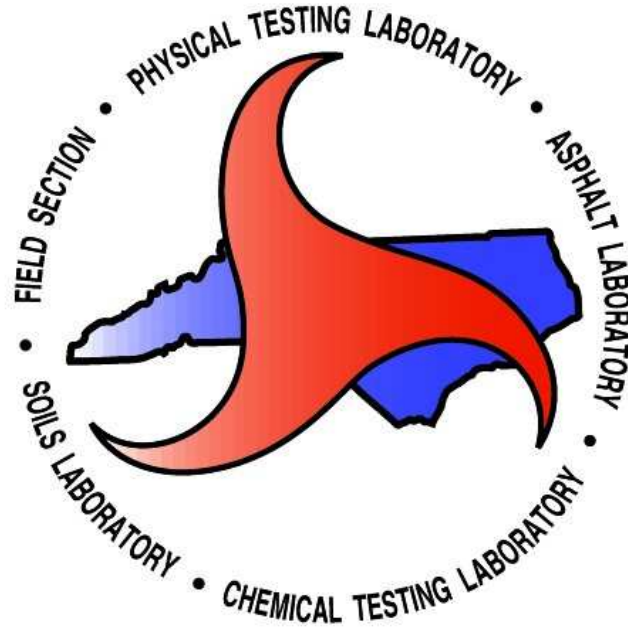


# Materials & Tests Unit



**NCDOT**

## ABC MATERIALS SCHOOL

2010 version

# SOILS LABORATORY

## TECHNICAL TRAINER STAFF

- David Dunn - Divisions 1, 2, and 4
- Kevin Blalock - Divisions 3, 6, and 8
- Johnny Gilliam - Divisions 5 and 7
- Scotty Jarman - Divisions 9, 10, and 12
- J.J. Myers - Divisions 11, 13, and 14

# MANUFACTURING AGGREGATE

WHY DO WE HAVE  
SPECIFICATIONS?

- ABC IS A MANUFACTURED PRODUCT AND DUE TO ITS EXPOSURE TO WATER AND DYNAMIC LOADING, SPECIFICATION REQUIREMENTS WERE ESTABLISHED TO ENSURE THE PRODUCT WOULD HAVE DESIRABLE PERFORMANCE
- FOR “THIN” ASPHALT PAVEMENT (FLEXIBLE PAVEMENT), THE ABC IS THE PRIMARY LOAD-BEARING ELEMENT

IT BEGINS WITH THE DESIGN PROCESS...

PAVEMENT DESIGN ENGINEERS USE LAYER  
COEFFICIENTS FOR THE DIFFERENT TYPES  
OF MATERIALS THAT MAKE UP A PAVEMENT  
STRUCTURE

FOR EXAMPLE...

(BASE LAYER) B 25.0 ASPHALT..	0.30 (PER INCH)
ABC.....	0.14 (PER INCH)
CTBC.....	0.23 (PER INCH)
LIME STAB. SUBGRADE.....	0.13 (PER INCH)

SINCE THE LAYER COEFFICIENT OF ABC IS  
BASED ON MATERIAL MEETING CERTAIN  
GRADATION REQUIREMENTS...



IT IS IMPORTANT TO MONITOR GRADATION  
OF THE MATERIAL BEING PLACED TO ENSURE  
IT WILL PERFORM AS INTENDED

GRADATION REQUIREMENTS ARE DESIGNED TO  
CREATE A WELL-GRADED BLEND OF  
AGGREGATE WHICH...

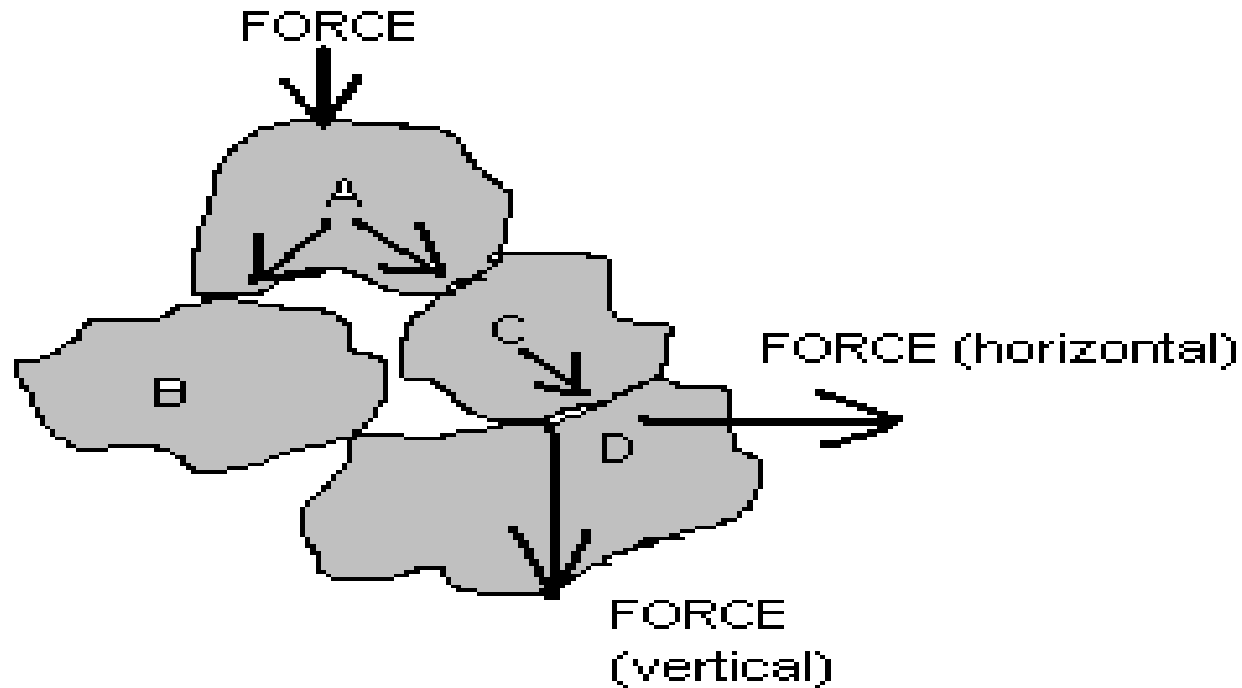
- INCREASES NUMBER OF FILLION POINTS
- INCREASES THE INTERLOCKING BETWEEN  
PARTICLES
- DECREASES VOIDS

**VARIOUS SIZE AGGREGATE SEPERATED**





# TRANSMISSION OF FORCE THROUGH THE AGGREGATE



- STRENGTH IS CREATED FROM FICTION AND INTERLOCKING BETWEEN ADJACENT PARTICLES

DUE TO THE ABC BEING EXPOSED TO WATER,  
LIQUID LIMIT AND PLASTICITY INDEX  
ARE ALSO CRITICAL COMPONENTS

- LIQUID LIMIT (L.L.)

THE WATER CONTENT AS DETERMINED BY THE  
STANDARD LIQUID LIMIT TEST, AT WHICH A SOIL  
PASSES FROM A PLASTIC TO A LIQUID STATE

- PLASTIC LIMIT (P.L.)

THE LOWEST WATER CONTENT, AS DETERMINED  
BY THE STANDARD PLASTIC LIMIT TEST, AT WHICH  
A SOIL REMAINS PLASTIC

- PLASTICITY INDEX (P.I.)

$$P.I. = L.L. - P.L.$$



**LIQUID LIMIT**



**PLASTIC LIMIT**

THE LIQUID LIMIT AND PLASTIC LIMIT ARE  
DETERMINED ON THE MATERIAL PASSING THE  
# 40 SIEVE

A HIGH LIQUID LIMIT INDICATES A HIGH CLAY  
CONTENT AND LOW LOAD-CARRYING CAPACITY

LOAD-CARRYING CAPACITY OF A SOIL INCREASES  
RAPIDLY BELOW THE PLASTIC LIMIT AND DECREASES  
RAPIDLY ABOVE THE PLASTIC LIMIT

**TABLE 1010-1**  
**AGGREGATE BASE COURSE GRADATION ACCEPTANCE RANGE**

<b>Column A</b>	<b>Column B % Passing</b>	<b>Column C % Passing</b>	<b>Column D Range</b>	<b>Column E</b>
<b>1 1/2"</b> <b>(37.5 mm)</b>	<b>100</b>	<b>98 - 100</b>	<b>3</b>	<b>1</b>
<b>1"</b> <b>(25.0 mm)</b>	<b>75 - 97</b>	<b>72 - 100</b>	<b>15</b>	<b>1</b>
<b>1/2"</b> <b>(12.5 mm)</b>	<b>55 - 80</b>	<b>51 - 83</b>	<b>20</b>	<b>1</b>
<b># 4</b> <b>(4.75 mm)</b>	<b>35 - 55</b>	<b>35 - 60</b>	<b>18</b>	<b>3</b>
<b># 10</b> <b>(2.00 mm)</b>	<b>25 - 45</b>	<b>20 - 50</b>	<b>18</b>	<b>2</b>
<b># 40</b> <b>(0.425 mm)</b>	<b>14 - 30</b>	<b>10 - 34</b>	<b>14</b>	<b>3</b>
<b># 200</b> <b>(0.075 mm)</b>	<b>4 - 12</b>	<b>3 - 13</b>	<b>7</b>	<b>5</b>
<b>Material Passing No. 10 Sieve (Soil Mortar)</b>				
<b># 40</b> <b>(0.425 mm)</b>	<b>40-84</b>	<b>36-86</b>	<b>35</b>	<b>2</b>
<b># 200</b> <b>(0.075 mm)</b>	<b>11-35</b>	<b>10-36</b>	<b>20</b>	<b>2</b>
<b>Material Passing No. 40 Sieve</b>				
<b>L. L.</b>	<b>0-30</b>	<b>0-30</b>	<b>-</b>	<b>-</b>
<b>P. I.</b>	<b>0-6</b>	<b>0-6</b>	<b>-</b>	<b>-</b>



# GRADATION DISTRIBUTION CURVE

PERCENT PASSING

100  
90  
80  
70  
60  
50  
40  
30  
20  
10  
0

#200

#40

#10

#4

1/2"

1"

1 1/2"

SIEVE SIZE

TARGET RANGE

COLUMN "C" UPPER RANGE

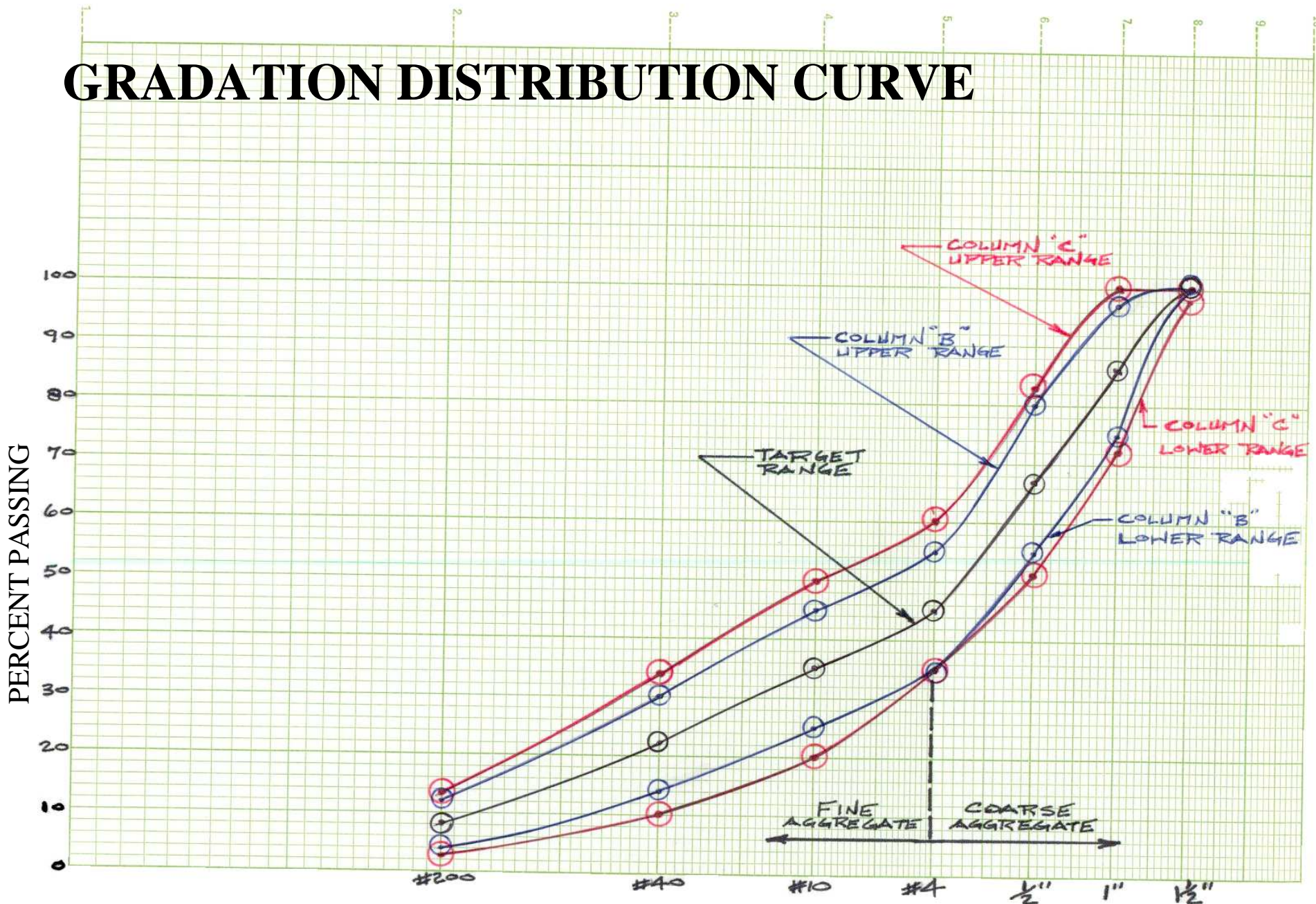
COLUMN "B" UPPER RANGE

COLUMN "C" LOWER RANGE

COLUMN "B" LOWER RANGE

FINE AGGREGATE

COARSE AGGREGATE



**COARSE MATERIAL  
RETAINED ON THE 1" SIEVE**

**DIFFICULT OR IMPOSSIBLE  
TO COMPACT**

**HIGH VOID CONTENT**







**DIFFICULT OR IMPOSSIBLE  
TO COMPACT**

**HIGH VOID CONTENT**

**COARSE MATERIAL  
RETAINED ON THE 1/2" SIEVE**

**DIFFICULT OR IMPOSSIBLE  
TO COMPACT**

**COARSE MATERIAL  
RETAINED ON THE #4 SIEVE**

**HIGH VOID CONTENT**



**FINE MATERIAL  
PASSING THE #4 SIEVE**



**LOW VOID CONTENT**

**RELATIVELY EASY TO COMPACT  
BUT LOW STRENGTH**

## BLEND OF DIFFERENT SIZE AGGREGATE





**MATERIAL IS MIXED WITH WATER AND COMPACTED,  
FEW VOIDS AND GREATER STRENGTH**

# QC/QA PROGRAM

# **PURPOSE**

Page 2

- NCDOT IN A JOINT VENTURE WITH THE AGGREGATE INDUSTRY CREATED THE **QC/QA PROGRAM**
- STONE PRODUCERS PERFORM QUALITY CONTROL (QC) SAMPLING AND TESTING
- NCDOT PERFORMS QUALITY ASSURANCE (QA) TESTING AND MONITORS THE PRODUCER'S QC PROGRAM

- UNDER THE QC/QA PROGRAM, THE PRODUCER PULLS A QC SAMPLE AT THE QUARRY AND PROCESSES IT
- GRADATION RESULTS ARE CHECKED AGAINST SPECS (TABLE 1010-1) FOR ACCEPTANCE
- RESIDENT ENGINEERS ARE SCHEDULED TO RECEIVE RESULTS WITHIN 72 HOURS (REFER TO QC/QA PROGRAM AND TESTING MANUALS FOR FURTHER DETAILS)



# **AGGREGATE BASE COURSE**

## **DEFINITION AND TYPES**

## DEFINITION

**ABC** : A BASE COMPOSED OF AN APPROVED AGGREGATE MATERIAL HAULED TO THE ROAD, PLACED ON THE ROAD, COMPACTED, AND SHAPED TO THE LINES, GRADES, DEPTHS, AND TYPICAL SECTIONS SHOWN IN THE PLANS OR ESTABLISHED BY THE ENGINEER. (520-1)

## **TYPES OF ABC** **(TWO TYPES)**

TYPE A ABC : IS SAMPLED BY THE  
**PRODUCER** FROM THE PRODUCTION  
PILE IN 2000 TON LOTS.  
(PRODUCTION PILE CAN HAVE  
MATERIAL SHIPPED OUT WHILE  
NEW MATERIAL IS ADDED)

## **TYPES OF ABC (continued)**

**Page 3**

TYPE B ABC : IS SAMPLED BY THE **PRODUCER** FROM AN “APPROVED” STOCKPILE, WHICH HAS SPECIFIC PERMISSIBLE DIMENSIONS IN TERMS OF LAYER THICKNESS, TONNAGE PER LAYER, ETC. (NO MATERIAL CAN BE HAULED FROM AN APPROVED STOCKPILE UNTIL THE PILE IS COMPLETED, TESTED, AND APPROVED BY THE STATE SOILS ENGINEER)

# TYPE B ABC “APPROVED” STOCKPILE

5 LAYERS



## **TYPES OF ABC (continued)**

TYPE B ABC : **PRODUCER**

**PULLS QC SAMPLES IN 2000 TON  
LOTS**

# HAULING AND PLACEMENT

PRIOR TO DELIVERY OF ANY AGGREGATE MATERIAL, THE INSPECTOR SHOULD REVIEW THE FOLLOWING:

- RELATED SECTIONS OF THE SPECIFICATIONS
- RELATED SECTIONS OF THE CONSTRUCTION MANUAL
- PLANS
- PROJECT SPECIAL PROVISIONS



REMINDER:

IMPROPER LOADING, PLACEMENT, OR  
MANIPULATING CAN TURN ACCEPTABLE  
MATERIAL INTO UNACCEPTABLE MATERIAL

PROPER PLACEMENT:

- PLACE MATERIAL AT OR NEAR OPTIMUM  
MOISTURE
- UTILIZE A MECHANICAL SPREADER BOX  
(AVOID TAILGATE DUMPING)
- AS A GENERAL RULE-ADD APPROXIMATELY  
1/3 THICKNESS TO ACHIEVE THE DESIRED  
COMPACTED THICKNESS

- THE REAR TRUCK TIRES SHOULD REMAIN IN CONTACT WITH THE SPREADER BOX AS ABC IS BEING DUMPED
- WHEN THE EQUIPMENT MOVES FORWARD THE TRUCKBED SHOULD BE RAISED AS THE THE LEVEL OF ABC IN THE MECHANICAL SPREADER BOX DROPS
- AVOID OVERFILLING THE MECHANICAL SPREADER BOX
- THE MECHANICAL SPREADER BOX SHOULD BE KEPT 1/3 FULL TO PREVENT SEGREGATION

# **SAFETY ISSUE!**

**ANY TIME A DUMP TRUCK IS RAISING THE  
BED TO DUMP MATERIAL BE AWARE  
OF NEARBY POWERLINES**

**ALWAYS BE AWARE OF ANY MOVING  
VEHICLES OR CONSTRUCTION EQUIPMENT**

**DO NOT EXCEED 35 MPH WITH HAULING  
EQUIPMENT TRAVELING OVER ANY PART  
OF THE BASE (520-5)**

AS AGGREGATE MATERIAL IS DELIVERED,  
PROJECT PERSONNEL SHOULD COLLECT  
THE WEIGH TICKETS AND MAINTAIN PROPER  
RECORDS TO ENSURE...

- THE CONTRACTOR IS PAID FOR PRODUCTS  
DELIVERED AND...
- IF ANY AGGREGATE FAILS TO MEET  
SPECIFICATIONS IT CAN BE LOCATED

## PROPER RECORD KEEPING...

THE METHOD OF PAYMENT FOR ABC MATERIAL IS BASED ON THE WEIGH TICKET THEREFORE TO ENSURE PROPER RECORD KEEPING, FOLLOW GUIDELINES IN THE “RECORD AND REPORTS” SECTION (page R-110) OF THE **NCDOT CONSTRUCTION MANUAL**

# ROADWAY ASSURANCE SAMPLING

# IMPORTANCE OF PROPER SAMPLING



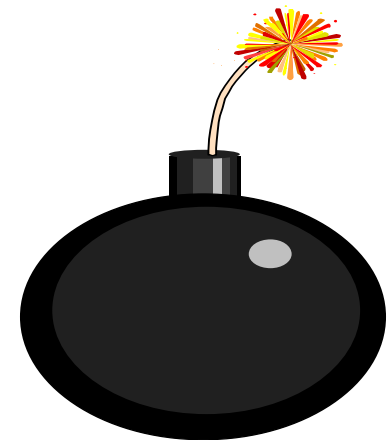
## DEFINITION

**SAMPLE** : IS A PORTION, PIECE, OR  
SEGMENT THAT IS REPRESENTATIVE  
OF A WHOLE



PENALTIES ARE APPLIED WHEN A  
SAMPLE FAILS TO MEET THE  
SPECIFICATION REQUIREMENTS  
WHICH CAN LEAD TO A **REDUCTION  
IN PAY OR REJECTION OF THE ABC**

THEREFORE SAMPLING ABC WITH  
THE **PROPER PROCEDURES** CAN NOT  
BE OVEREMPHASIZED



- BOTH **TYPE A ABC** AND **TYPE B ABC** ARE TESTED BEFORE THE MATERIAL LEAVES THE QUARRY BY THE PRODUCER AND THE NCDOT
- HOWEVER ROADWAY (RA) SAMPLES ARE OBTAINED TO ENSURE THE MATERIAL HAS MAINTAINED THE SAME QUALITY AS AT THE QUARRY

- WHEN SAMPLING FROM ROADWAY  
A NCDOT APPROVED SAMPLING  
RING MUST BE USED
- THE SAMPLING RING **ISOLATES  
THE SAMPLE FROM THE REST THE  
OF ROADWAY**
- EACH TEST WILL REQUIRE A RA  
SAMPLE PAIR “A” AND “B”

- BOTH “A” AND “B” MUST WEIGH  
**70 POUNDS DRY** TO BE PROCESSED

- Samples for gradation need to be obtained on the roadway (520-6), by a certified ABC sampling technician, behind the placing operation, prior to compaction, using random numbers for the width and tonnage.
- Care should be taken not to contaminate ABC sample with subgrade material when collecting sample from the roadway using NCDOT sampling ring.

## **EQUIPMENT:**

1. STEEL SAMPLING RING  
(12-INCH DIA. , 9-INCH DEEP)
2. SCOOP/LARGE SPOON
3. SMALL PICK
4. SAMPLE BAGS (GOOD CONDITION)  
AND SAMPLE CARDS
5. WOODEN Mallet

# **PROCEDURE:**

**Page 10**

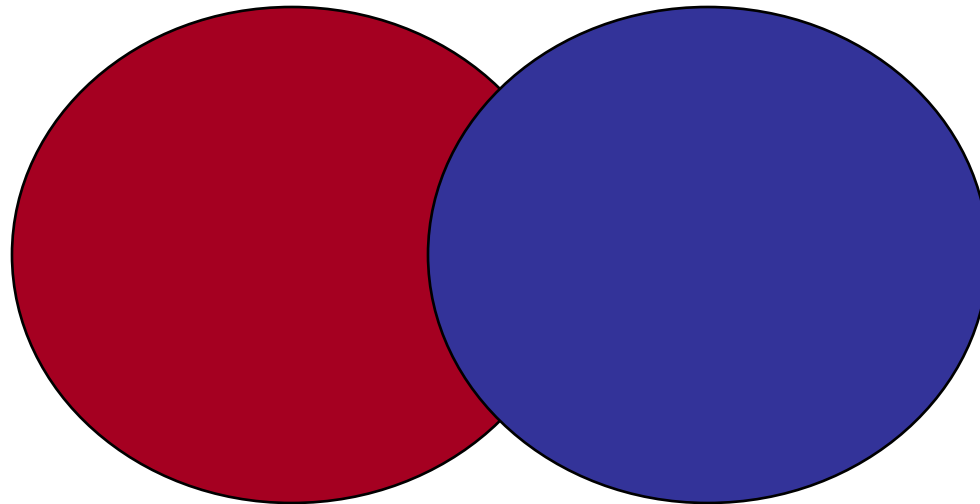
1. PLACE SAMPLE RING ON FLAT SURFACE OF MATERIAL TO BE TESTED
2. USE PICK TO CAREFULLY LOOSEN MATERIAL WITHIN THE RING AND REMOVE WITH SCOOP OR LARGE SPOON AND PLACE IN SAMPLE BAG
3. LOWER THE RING AS MATERIAL IS REMOVED BY TWISTING OR LIGHTLY TAPPING THE RING WITH

3. A WOODEN MALLET. REMOVE ALL THE MATERIAL DOWN TO THE FULL DEPTH OF THE LAYER
4. IF TWO FULL BAGS HAVE BEEN OBTAINED AFTER THE RING REACHES THE BOTTOM OF THE LAYER, GO TO STEP 6. IF NOT MOVE THE RING OVER SUCH THAT THE NEW POSITION OF THE RING OVERLAPS THE PREVIOUS POSITION



# MOVING SAMPLING RING

FIRST BAG FULL



SECOND BAG FULL

TOP VIEW

5. REPEAT STEPS 2 TO 4
6. COMPLETELY FILL OUT A  
SAMPLE CARD FOR EACH BAG.  
PLACE CARD IN A CLEAR  
PLASTIC BAG AND THEN PLACE  
IN EACH SAMPLE BAG.

# **SAMPLING FREQUENCY**

## **RA SAMPLING**

# TYPE A ABC OR TYPE B ABC

Page 3

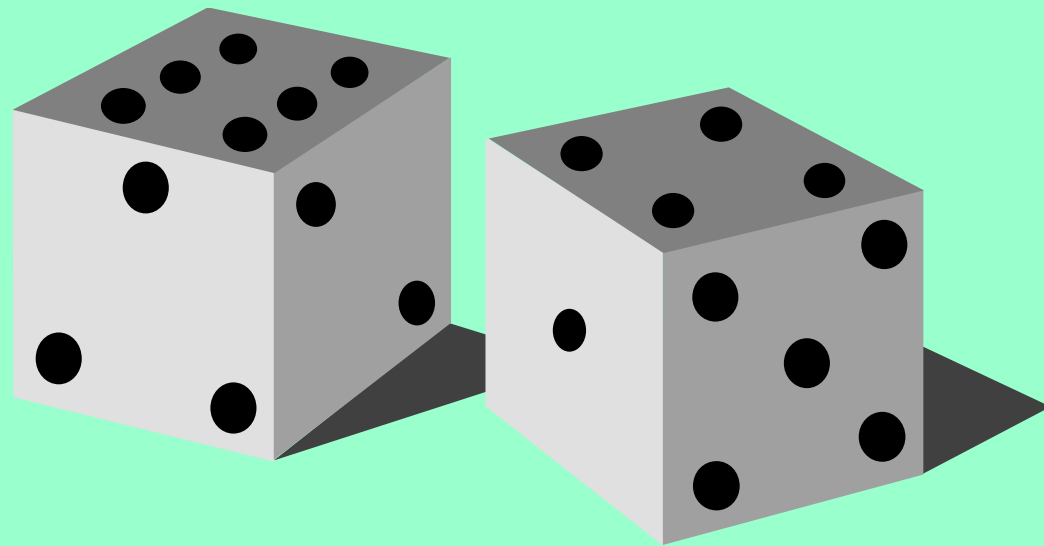
- PULL A SAMPLE PAIR EVERY 5000 TONS OR FRACTION THEREOF PLACED (1010-2)(C)
- THE “A” SAMPLE IS PULLED FROM THE FIRST 2500 TONS
- THE “B” SAMPLE IS PULLED FROM THE SECOND 2500 TONS

## **NOT IN MANUAL**

- **WHEN ABC IS PLACED IN TWO LAYERS, CLOSE OUT THE FIRST LAYER ( I. E. obtain both A and B samples from one layer only)**
- **HAVE EACH LAYER OF MATERIAL SAMPLED, TESTED, COMPACTED, AND APPROVED PRIOR TO PLACING SUCCEEDING LAYER OF BASE MATERIAL OR PAVEMENT (520-5).**

# RANDOM NUMBERS

## EXAMPLE PROBLEM



- USE RANDOM NUMBERS TO  
LOCATE SAMPLING SITES IN ORDER  
TO **PREVENT BIASED SAMPLING**  
(1010-2)(C)

## EXAMPLE 1

Page 12

(ASSUME 12' LAYDOWN WIDTH)  
RANDOM NUMBERS ARE AS FOLLOWS:

<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	←	COLUMN NUMBERS
7	3	1	6		
3	2	0	4		
2	9	7	6		
8	3	0	3		
5	5	5	6		



## **EXAMPLE 1 (CONT)**

**Page 12**

- LOT SIZE 5000 TONS

**5000 TONS**

## EXAMPLE 1 (CONT)

Page 12

- TAKE THE “A” SAMPLE FROM THE FIRST 2500 TONS AND THE “B” SAMPLE FROM THE SECOND 2500 TONS

2500 TONS “A”

2500 TONS “B”

## EXAMPLE 1 (CONT)

Page 12

UTILIZE RANDOM NUMBERS (7316)

2500 TONS “A”

“A” SAMPLE TAKEN AT:

2500 TONS X 0.73 = 1825 TONS

12' X 0.16 = 2' FROM EDGE

PULL THE “A” SAMPLE

## EXAMPLE 1 (CONT)

Page 12

UTILIZE RANDOM NUMBERS (3204)

2500 TONS “B”

“B” SAMPLE TAKEN AT:

$$2500 \text{ TONS} \times 0.32 = 800 \text{ TONS}$$

$$800 + 2500 = 3300 \text{ TONS}$$

$$12' \times 0.04 = .48' < 2' \text{ USE } 2'$$

PULL “B” SAMPLE

**SAMPLING ABC**

**STABILIZER AGGREGATE**

## **STABILIZER AGGREGATE “S.A.”**

- **UTILIZED TO STABILIZE SUBGRADE SOILS**
- **A TWO TO THREE INCH LAYER OF S.A. IS ADDED AND MECHANICALLY MIXED WITH THE SOIL (510-3)**

## **SAMPLING STABILIZER AGGREGATE**

- IN ORDER TO OBTAIN A REPRESENTATIVE SAMPLE, THE S.A. **MUST BE SAMPLED FROM THE SPREADER BOX**
- EACH TEST REQUIRES A “RA” SAMPLE PAIR “A” AND “B”
- EACH SAMPLE PAIR MUST WEIGH 70 LBS EACH TO BE PROCESSED

- **SAMPLING LOT SIZE FOR S.A. IS  
5000 TONS**
- **USE RANDOM NUMBERS TO  
DETERMINE SAMPLING SITE  
(PREVENT BIASED SAMPLING)**



- WHEN THE TRUCK DUMPS THE MATERIAL IN THE SPREADER BOX, TYPICALLY A CONICALLY SHAPED PILE IS FORMED
- STRIKE OFF THE PILE TO CREATE A FLAT SURFACE FOR SETTING THE SAMPLING RING

- **PLACE THE SAMPLING RING ON THE EXPOSED FLAT SURFACE AND SAMPLE ENOUGH MATERIAL TO FILL TWO BAGS OR A MINIMUM 70 LBS (AS DISCUSSED PREVIOUSLY)**

# **SAMPLING ABC**

## **CEMENT TREATED BASE COURSE (C. T. B. C.)**

## C.T.B.C.

- CEMENT IS ADDED TO ABC
- **PLANT-MIXED** CTBC HAS THE CEMENT ADDED AT THE PLANT IN A PUGMILL (540-5)(B)
- **ROAD-MIXED** CTBC HAS THE CEMENT ADDED AFTER THE ABC IS PLACED ON THE ROADWAY (540-5)(C)

# PLANT-MIXED CTBC

Page 4

- CEMENT IS ADDED ALONG THE CONVEYOR BELT
- MUST SAMPLE BEFORE CEMENT IS ADDED
- SAMPLING LOT SIZE IS 5000 TONS

- **USE RANDOM NUMBERS TO DETERMINE THE TONNAGE TO PULL THE SAMPLE**
- **EACH TEST WILL REQUIRE AN “A” AND “B” SAMPLE (EACH SAMPLE MUST WEIGH 70 LBS EACH)**

**EQUIPMENT:**

1. FLAT TIP SHOVEL
2. BRUSH
3. 5-GALLON BUCKET
4. SCOOP
5. SAMPLE BAGS
6. SAMPLE CARDS

## **PROCEDURES:**

1. USE RANDOM NUMBERS TO  
DETERMINE TONNAGE TO PULL  
SAMPLE
2. STOP CONVEYOR BELT AT  
APPROPRIATE TONNAGE
3. USE FLAT-TIP SHOVEL TO ISOLATE  
APPROXIMATELY AN 18 TO 24 INCH  
SECTION



4. USING THE SCOOP, PLACE THE MATERIAL IN THE BUCKET
5. REMOVE ALL THE MATERIAL FROM THE ISOLATED SECTION INCLUDING THE FINES AND PLACE IN THE BUCKET
6. CAREFULLY TRANSFER THE MATERIAL TO THE SAMPLE BAGS AND PLACE COMPLETED CARDS IN EACH BAG

## **ROAD-MIXED CTBC**

- **SAMPLE THE ABC ON THE ROADWAY PRIOR TO ADDING THE CEMENT**
- **FOLLOW THE SAME PROCEDURES AS THOSE USED FOR OBTAINING ABC SAMPLES ON THE ROADWAY**

# **SAMPLE IDENTIFICATION AND NUMBERING**

# **SAMPLE IDENTIFICATION AND NUMBERING**

Page 5

- SAMPLES ARE GIVEN AN “RA” DESIGNATION FOLLOWED BY THE NUMBER AND AN “A” OR “B”
- NUMBERING WILL START WITH “1” AND RUN CONSECUTIVELY FOR THE ENTIRE PROJECT

FOR EXAMPLE:

THE FIRST SAMPLE PAIR TAKEN  
ON THE PROJECT WILL BE LABELED  
RA-1A (2 BAGS MINIMUM OF 70 LBS)  
RA-1B (2 BAGS MINIMUM OF 70 LBS)

THE SECOND SAMPLE PAIR TAKEN  
ON THE PROJECT WILL BE LABELED  
RA-2A (2 BAGS MINIMUM OF 70 LBS)  
RA-2B (2 BAGS MINIMUM OF 70 LBS)

**PLACE EACH SAMPLE CARD IN  
A PLASTIC BAG TO PROTECT IT**

**PLACE A SAMPLE CARD IN  
EACH BAG**

**BOTH “A” AND “B” SAMPLES  
MUST BE TURNED IN AT THE  
SAME TIME**

- FOR FILLING OUT A SAMPLE CARD  
FOLLOW THE EXAMPLE ON **PAGE**  
**6** IN MANUAL

# FAILURE OF RA SAMPLE





## **FAILURE OF RA SAMPLE**

**Type A ABC**

- RESIDENT ENGINEER WILL REQUEST A CHECK SAMPLE FROM THE SOILS ENGINEER.
- THE SAMPLING LOT (5000 TONS) WILL BE DIVIDED INTO TWO 2500 TON SUBLOTS AND A SAMPLE PAIR WILL BE OBTAINED FROM EACH SUBLLOT

- THE GRADATION RESULTS OF EACH SAMPLE PAIR SHALL BE AVERAGED TO DETERMINE ACCEPTANCE OF EACH SUBLLOT
- THE AVERAGES MUST FALL WITHIN COLUMN C OF TABLE 1010-1

- IF THE AVERAGES EXCEED ANY OF THE LIMITS ON COLUMN C, AND THE TEST RESULTS INDICATE THAT THE MATERIAL CAN BE CORRECTED, THE SECTION CAN BE CORRECTED WITH APPROVAL FROM THE AREA ROADWAY CONSTRUCTION ENGINEER AND THE SOILS ENGINEER  
(AT NO COST TO THE DEPARTMENT)

- ONCE THE MATERIAL HAS BEEN CORRECTED, A SAMPLE PAIR IS TO BE OBTAINED FROM THE CORRECTED SUBLOT(S)  
(PROJECT PERSONNEL)
- THE AVERAGE GRADATION TEST RESULTS MUST FALL WITHIN COLUMN B OF TABLE 1010-1 TO BE CONSIDERED ACCEPTABLE (1010-2)(A)

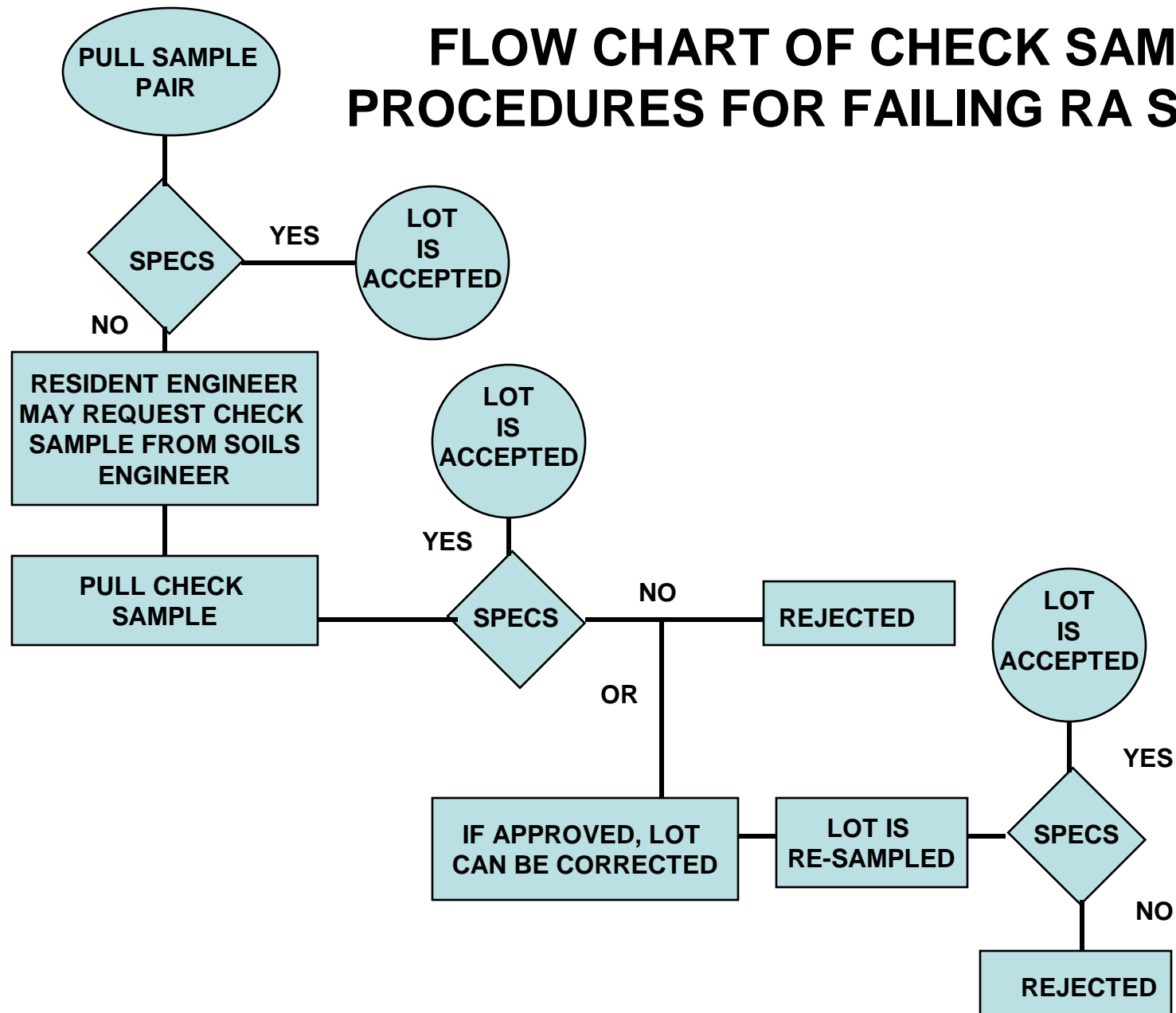
- WHEN THE AVERAGE GRADATION TEST RESULTS FOR A SUBLOT EXCEED ANY OF THE LIMITS SHOWN IN TABLE 1010-1 COLUMN C, AND THE SUBLOT CAN NOT BE CORRECTED, OR IF THE CORRECTED SUBLOT EXCEEDS ANY OF THE LIMITS OF TABLE 1010-1 COLUMN B, THE SUBLOT WILL BE REJECTED AND SHALL BE REMOVED AND REPLACED AT NO COST TO THE DEPARTMENT (520-6)

- THE REPLACEMENT MATERIAL  
SHALL MEET THE SPECIFICATION  
REQUIREMENTS FOR TYPE A ABC

## **FAILURE OF RA SAMPLE   TYPE B ABC**

- FOLLOW SAME PROCEDURES  
AS DISCUSSED ON THE PREVIOUS  
SLIDE. STEPS ARE SUMMARIZED ON THE  
FOLLOWING SLIDE

# FLOW CHART OF CHECK SAMPLE PROCEDURES FOR FAILING RA SAMPLE





# CHECK SAMPLES



# CHECK SAMPLES

Page 9

- THE CONTRACTOR MAY REQUEST THAT A CHECK SAMPLE BE TAKEN WHEN A TEST SAMPLE(S) FAILS TO MEET SPECIFICATIONS.
- THE CHECK SAMPLES MAY BE TAKEN BEFORE AND/OR AFTER CORRECTION.

- **THE CHECK SAMPLES ARE NAMED AS FOLLOWS: RA-1C, RA-1D, RA-1E, AND RA-1F, ETC.**

**COMPACTION OF ABC**

## ACHIEVING ADEQUATE COMPACTION FOR ABC OR CTBC BEGINS WITH...

- QUALITY AGGREGATE
- ADEQUATE FOUNDATION
- PROPER CONSTRUCTION EQUIPMENT
- PROPER CONSTRUCTION PRACTICES
- AN UNDERSTANDING OF LABORATORY METHODS FOR ESTABLISHING OPTIMUM MOISTURE AND MAXIMUM DRY DENSITY

A MOISTURE DENSITY CURVE OR “UNIT WEIGHT” IS PERFORMED ON QUARRIES THAT ARE SUPPLYING ABC TO THE DEPARTMENT...

- MATERIALS INSPECTOR SUBMITS A 4-BAG SAMPLE FROM EACH QUARRY TO THE SOILS LABORATORY
- THE SOILS LABORATORY PERFORMS A MOISTURE DENSITY CURVE ON THE ABC USING AASHTO T-180 PROCEDURES AS MODIFIED BY THE DEPARTMENT

- THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE ARE ESTABLISHED FOR EACH QUARRY ON THE APPROVED SOURCE LIST
- THE MAXIMUM DRY DENSITY IS USED AS THE TARGET DENSITY FOR PROJECT DENSITY CONTROL UNTIL THE NEXT UNIT WEIGHT IS PERFORMED, WHICH IS ABOUT EVERY 12 MONTHS

**THE 4 BAG SAMPLE IS DRIED AND PROCESSED ACROSS  
A GILSON SHAKER**







**MATERIAL IS DUMPED ON THE MIXING TABLE...**



...AND MIXED





**WATER IS ADDED...**



**...THE WATER IS MIXED IN UNTIL MOISTURE IS  
UNIFORMLY DISTRIBUTED**

THE MATERIAL IS PLACED IN THE MOLD IN 5 LAYERS

86 BLOWS PER LAYER



# MECHANICAL COMPACTOR

10 POUND HAMMER  
WITH AN 18-INCH  
DROP



**EXCESS MATERIAL IS SCRAPED OFF**







**PILL IS WEIGHED AND RECORDED**



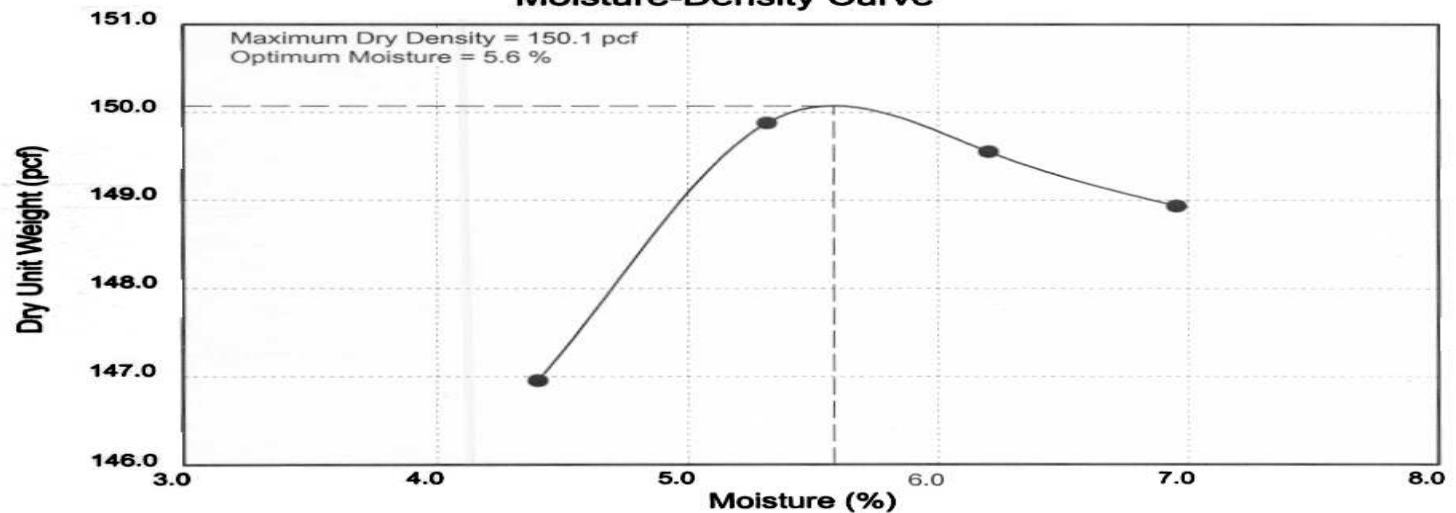
# **NORTH CAROLINA DEPARTMENT OF TRANSPORTATION MATERIALS AND TESTS UNIT**

## **MOISTURE DENSITY DETERMINATION**

<b>Project</b>	5.672	<b>Date</b>	7/1/2005
<b>TIP No.</b>	MM CHARLOTTE Q41	<b>Stone Content(%)</b>	0.0
<b>County</b>	Mecklenburg	<b>Bag Moisture (%)</b>	0.0
<b>Station</b>	SP	<b>Test Type</b>	AASHTO T-180
<b>Sample No.</b>	1-05	<b>Submitted By</b>	R.HISSOM
<b>Lab No.</b>	724040	<b>Tested By</b>	TDH
<b>Comments</b>	8400		

Mold Weight (g)		3980		Mold Volume(ft³)		0.114540	
Test No.	Weight of Mold+Soil (g)	Weight of Wet Soil (g)	Wet Unit Weight (pcf)	Wt. Wet Sample (g)	Wt. Dry Sample (g)	Water Content %	Dry Unit Weight (pcf)
1	11951.0	7971.0	153.4	7971.0	7635.0	4.40	147.0
2	12181.0	8201.0	157.8	8201.0	7787.0	5.32	149.9
3	12232.0	8252.0	158.8	8252.0	7770.0	6.20	149.6
4	12256.0	8276.0	159.3	8276.0	7738.0	6.95	148.9
5							
6							

**Moisture-Density Curve**



## THE FOLLOWING ITEMS CAN AID IN THE COMPACTION PROCESS

- TAKE THE NECESSARY STEPS TO ENSURE THE ABC IS AT OR NO MORE THEN 2 PERCENT ABOVE OPTIMUM MOISTURE FOR THE ENTIRE LAYER
- WHEN COMPACTING CTBC THE MATERIAL IS TO BE COMPACTED AT OR NO MORE THEN 1.5 PERCENT ABOVE OPTIMUM MOISTURE (540-6)

- WHEN THE COMPACTED DEPTH IS 8 TO 10 INCHES, A VIBRATORY SHEEPSFOOT CAN BE USED FOR A MAXIMUM OF 2 PASSES (540-6)
- A MOTORGRADER CAN EVEN THE SURFACE AND ADDITIONAL PASSES SHOULD BE MADE WITH THE VIBRATORY SMOOTH DRUM
- IF AVAILABLE, A PNEUMATIC ROLLER CAN FOLLOW THE VIBRATORY SMOOTH DRUM WITH THE FINAL PASSES MADE BY A SMOOTH DRUM ROLLER IN THE STATIC MODE TO FINISH THE SURFACE

- IF A NUCLEAR GAUGE IS AVAILABLE, DENSITY READINGS CAN BE TAKEN TO MONITOR THE COMPACTION OPERATION
- WHEN SETTING UP CTBC, COMPLETE FINAL COMPACTION WITHIN 3 HOURS AFTER THE WATER HAS BEEN ADDED TO THE MIXTURE (540-6)

# CONTACT INFORMATION:

## Technical Trainers

David Dunn

ddunn@ncdot.gov

Johnny Gilliam

cgilliam@ncdot.gov

Kevin Blalock

kblalock@ncdot.gov

Scotty Jarman

sjarman@ncdot.gov

JJ Myers

jjmyers@ncdot.gov

## Technical Training Staff Map



- |                                 |                |
|---------------------------------|----------------|
| •David Dunn – Div. 1, 2, 4, 5   | (252) 792-1405 |
| •Kevin Blalock – Div. 3, 6, 8   | (910) 893-6807 |
| •Johnny Gilliam – Div. 5, 7     | (919) 329-4150 |
| •Scotty Jarman – Div. 9, 10, 12 | (704) 289-1330 |
| •J.J. Myers – Div. 11, 13, 14   | (336) 679-8142 |